FEDERAL REPUBLIC OF GERMANY

GERMAN PATENT AND TRADEMARK OFFICE

12. **UNEXAMINED PATENT APPLICATION**

11. **DE 197 18 420 A1**

51. Int. Cl.[6]:
G 08 C 17/04
H 01 L 27/092
H 04 L 25/06
H 04 L 25/20
// H03K 19/18

21. Case No.: 197 18 420.0
22. Application date: April 30, 1997
43. Date application published: November 12, 1998

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56. Prior art documents cited:

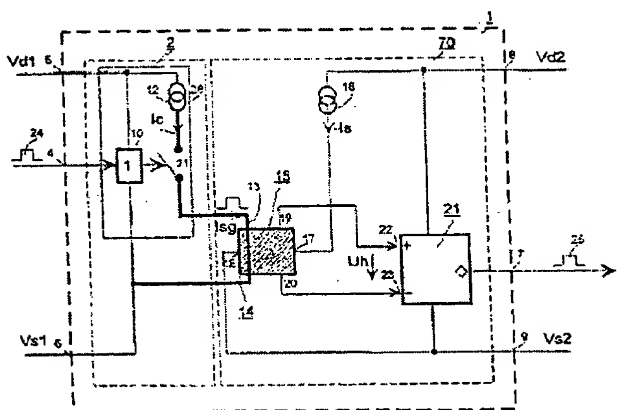
DE 42 15 956 C2

The following information has been taken from the documents submitted by the applicant.

Examination requested in accordance with § 44 of the Patent Code.

54. Integrated data transmission circuitry with electrical isolation between input and output circuit

57. Integrated data transmission circuitry with electrical isolation between input and output circuit. This circuitry contains an input circuit (2) with an input (4) for binary input signals (24), an output circuit (70) with an integrated, magneto-sensitive coupling element (15) and at least one output (7) which is driven by the coupling element and via which binary output signals (25) can be emitted. There are also conductor means (13, 14), by means of which input signals are transmitted into the geographical proximity of the coupling element in a manner that separates the voltages in the input and output circuits. An integrated Hall-effect generator is advantageously used as the coupling element,



Description

For the transmission of binary data in particular, it is frequently necessary to provide electrical isolation in the transmission path. The sequences of incoming binary data signals which are present with reference to a receiver circuitry are thereby transmitted into a sequencing circuit which is connected to a different voltage potential system. The transmission of the data between the receiving circuit and the sequencing circuit must therefore be done in an electrically isolated manner.

In similar systems of the prior art, electrically isolating transmission circuits of this type are realized in a circuit arrangement that consists of discrete components. The circuits are thereby generally based on the principle of an optical coupler, an inductive pulse transmitter or a capacitive coupler. For example, with an optical coupler, at least the transmitter diode of the electrical isolation path must be in the form of a discrete component. Furthermore, under some conditions, inductive pulse transmitters or capacitive couplers also require rather large inductive or capacitive discrete components.

The object of the invention is to indicate a data transmission circuit which can be fully integrated and therefore can be realized in the form of a single chip.

The invention teaches that this object is achieved by the data transmission circuit described in Claim 1. Additional advantageous embodiments of the invention are described in the subclaims.

The invention is explained in greater detail below with reference to the exemplary embodiments illustrated in the accompanying figures, in which

Figure 1 is a schematic diagram of the integrated data transmission circuitry claimed by the invention,

Figure 2 shows a first exemplary embodiment of the integrated data transmission circuitry taught by the invention with a controllable constant power source in the input circuit, and

Figure 3 illustrates one preferred exemplary embodiment of the integrated data transmission circuitry taught by the invention, whereby a Hall-effect generator is provided as the magneto-sensitive component.

Figure 1 is a schematic diagram of an integrated data transmission circuitry 1 as claimed by the invention. This circuitry contains an integrated input circuit 2 with at least one input 4. Binary input signals can be fed to this input 4. Figure 1 shows, by way of example, a pulse 24 of one such input signal. The data transmission circuit 1 further contains an integrated output circuit 70. This output circuit has an integrated magneto-sensitive coupling element 15. The output 7 of the output circuit 70 is driven by the magneto-sensitive coupling element 15. This output can be used to emit binary output signals, and Figure 1 shows, again by way of example, a pulse 25 of one such output signal.

The invention teaches that there are conductor means with which the input signals 24 or signals derived from them and corresponding to them in the input circuit 2 are conducted, in a manner which isolates the potentials in the input and output circuit 2 and 70 respectively from each other, to the vicinity of the integrated magneto-sensitive coupling element 15 in the output circuit 7. In the example illustrated in Figure 1, binary input signals 24 are conducted via the input 4, a conductor loop to the frame potential at the input 6 of the data transmission device 1. The invention teaches that the conductor loop has a conductor segment 13 which is located in the vicinity of the integrated magneto-sensitive coupling element 15. In the example illustrated in Figure 1, the conductor loop 13 is placed above the magneto-sensitive coupling element 15 which is underneath it. An arrangement of this type can be achieved when the circuitry taught by the invention is constructed in integrated form, e.g. using C-MOS technology, by locating an isolation layer 14, e.g. one made of silicon dioxide, between the upper side of the integrated magneto-sensitive coupling element 15 and the conductor loop 13, as a result of which the desired electrical isolation between the input circuit 2 and the output circuit 70 is achieved. If a binary data pulse 24 is fed into the input 4 of the integrated magneto-coupler taught by the invention, its current flow produces a local magnetic field, especially around the conductor segment 13. This pulse-like magnetic field is detected by the neighboring magneto-sensitive coupling element 15 in the output

circuit. As a result, an additional signal pulse is emitted which in the illustrated example is fed from the output 7 via the two connections 19, 20 on the magneto-sensitive component 15 to the conductor loop which extends to the output 9. In the example illustrated in Figure 1, the active potential of this signal pulse 25 appears at the output 7, while the output 9 of the data transmission device 1 is in turn connected to a frame potential.

The circuitry taught by the invention has the advantage that a fully integrated construction without discrete components is possible. The magneto-sensitive component makes possible the isolation of binary input signals which are referenced to the current potential in the input circuit 2 from the output signals derived from them and which are referenced to the current potential in the output circuit 7. In the example illustrated in Figure 1, for example, the connections 6 and 9 of the data transmission circuitry are connected with different ground circuits.

The integrated magneto-sensitive coupling element 15 can preferably be constructed in the form of a Hall-effect generator. A realization of this type is described in greater detail below with reference to the exemplary embodiment illustrated in Figure 3. It is also possible to construct the integrated magneto-sensitive coupling element 15 in the form of an integrated AMR anisotropic magneto-sensitive component or an integrated GMR giant magneto-sensitive component.

In an additional realization illustrated by way of example in Figure 2, the integrated input circuit 2 of the integrated data transmission circuit 1 can have a first controllable constant power source 26. In one realization, its constant current Ic can be turned on and off in a controlled manner in synchronization with binary input signals 24 at the input 4. Uni-polar pulses then occur in the conductor 13. In another realization not illustrated in the examples, the constant current can be controlled by the clock pulse of the binary input signals, or the sign of the pulse can also be reversed. In that case, bipolar pulses occur in the conductor 13. As a result, a clocked signal current Isg occurs which the invention teaches is in turn conducted in an electrically isolated manner via the conductor segment 13 into the vicinity of the integrated magneto-sensitive coupling element 15 in the output circuit 7. The signal current Isg in turn triggers a

corresponding, electrically isolated output signal via the magneto-sensitive coupling element 15 in the output circuit 70.

Finally, Figure 3 illustrates in detail a preferred embodiment of the integrated data transmission circuitry taught by the invention, whereby an integrated Hall-effect generator is provided as the magneto-sensitive component.

The input circuit 2 is thereby connected to a potential system which consists of a positive power supply voltage Vd1 at the input 5 and a reference potential Vs1, in particular a frame potential, at the input 6. The output circuit 70 is connected to another potential system which consists of a positive power supply voltage Vd2 at the input 8 and an isolated reference potential Vs2, in particular a frame potential, at the input 9.

In the example of the integrated data transmission circuitry 1 illustrated in Figure 3, the first, controllable constant power course 26 advantageously has an integrated constant power source 12 which is located in a conductor loop, the ends of which are connected to the power supply voltage Vd1 and to the reference voltage Vs1. Furthermore, the conductor segment 13 located in the vicinity of the integrated magneto-sensitive coupling element 15 is an essential component of this conductor loop. This conductor segment 13 is represented by a bold line in the example illustrated in Figure 3. The element 26 advantageously also comprises an integrated digital driver 10 to which the binary input signals 24 are fed. This driver is also fed via corresponding connections by the voltages Vd1, Vs1 of the first voltage system. The driver 10 times an integrated circuit element 11 which is connected in series with the integrated constant power source 12 and emits a timed signal current Isg from the constant current Ic corresponding to the input signal 24, which signal current Isg acts via the conductor segment 13 in an electrically isolated manner as described above on the magneto-sensitive coupling element 15.

The controllable constant current source 26 illustrated in Figure 3 has the advantage that, largely independently of current potential fluctuations of the input signals 24, in any case sufficient strong, equal-frequency signal current pulses Isg to the magneto-sensitive coupling element 15 can be generated, and can be converted there without error into corresponding signal current chains in the output circuit.

In the embodiment of the integrated data transmission circuitry illustrated in Figure 3, the magneto-sensitive coupling element 15 is advantageously realized in the form of an integrated Hall-effect element. This element is supplied via the connections 17, 18 with a control current Is which is a requirement for the emission of a Hall-effect voltage Uh at the outputs 19, 20. The control current is provided by a second constant current source 16, which is fed on one hand via the input 8 of the integrated data transmission element by the voltage Vd2 and on the other hand via the input 9 by the voltage Vs2 from the second potential system of the output circuit 70. If a clocked signal current Isg thus occurs caused by a binary input signal 24, an electrically isolated Hall-effect voltage Uh is brought about in the integrated Hall-effect element. This can be conducted as the output signal directly to the output 7 of the data transmission circuit.

In the advantageous exemplary embodiment of the invention illustrated in Figure 3, the integrated output circuit 70 also has an integrated digital comparator 21 to which is fed the voltage Uh at the output of the integrated magneto-sensitive coupling element 15 at the comparator inputs 22 and 23. This arrangement has the advantage that via the output of the digital comparator 21, a binary output signal 25 that complies in all respects with the conventions of binary logic can be emitted at the output 7 of the data transmission circuitry.

Claims

1. Integrated data transmission circuitry (1) with
   a) an integrated input circuit (2) with at least one input (4) to which binary input signals (24) can be fed,
   b) an integrated output circuit (70) with
      b1) an integrated, magneto-sensitive coupling element (15), and
      b2) at least one output (7) which is controlled by the magneto-sensitive coupling element (15) and via which binary output signals (25) can be emitted, and with
   c) Conductor means (13, 14), with which the input signals (24) or corresponding signals (Isg) in the input circuit (2) can be conducted in a manner which isolates the voltages (Vd1, Vs1; Vd2, Vs2) in the input and output circuits (2; 70) into the vicinity of the integrated magneto-sensitive coupling element (15) in the output circuit (70).

2. Integrated data transmission circuitry as claimed in Claim 1, whereby the integrated input circuit (2)
   a) has a first controllable constant current source (26) which emits a clocked signal current (Isg) by the binary input signals (24), and
   b) the clocked signal current (Isg) is conducted in an electrically insulating manner into the vicinity of the magneto-sensitive coupling element (15) in the output circuit (70).

3. Integrated data transmission circuitry as claimed in Claim 2, whereby the first controllable constant current source (26) has
   a) an integrated constant current source (12),
   b) an integrated, digital driver (10), to which the binary input signals (24) are fed,

c) an integrated switching element (11) which is connected in series with the integrated constant current source (12) and, clocked by the signals at the output of the digital driver (10), emits the clocked signal current (Isg).

4. Integrated data transmission circuitry as claimed in one of the preceding claims, whereby the integrated output circuit (70) has an integrated digital comparator (21) to which is fed the voltage (Uh) at the output of the integrated, magneto-sensitive coupling element (15) at the comparator inputs (22, 23), and via the output (7) of which the binary output signals (25) can be emitted.

5. Integrated data transmission circuitry as claimed in one of the preceding claims, whereby the integrated magneto-sensitive coupling element (15) is constructed in the form of an integrated Hall-effect generator.

6. Integrated data transmission circuitry as claimed in one of the Claims 1 to 4, whereby the integrated magneto-sensitive coupling element (15) is constructed in the form of an integrated anisotropic magnetic resistance (AMR) component.

7. Integrated data transmission circuitry as claimed in one of the Claims 1 to 4, whereby the integrated magneto-sensitive coupling element (15) is constructed in the form of a giant magneto-sensitive (GMR) component.

8. Integrated data transmission circuitry as claimed in one of the preceding claims, whereby the data transmission circuitry is integrated using C-MOS technology.

3 pages of drawings